EX PARTE OR LATE FILED

Bell Atlantic

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Marie C. Johns
Executive Director - Regulatory Relations

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

January 10, 1994

EX PARTE

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W. Room 222
Washington, D.C. 20554

Re: CC Docket 92-297

Dear Mr. Caton:

Please include the attached information in the public record in the above referenced proceeding. Copies of the attachment were hand delivered to the addressees today.

If you have any questions, please call me.

Sincerely,

Marie C. Johns

Attachment

cc: Chairman Hundt
Commissioner Barrett
Commissioner Duggan
Commissioner Quello

No. of Copies rec'd 0+1
List ABCDE

Bell Atlantic
Enterprises

Bell Atlantic Enterprises Business Development, Inc.
1310 North Court House Road
Arlington, VA 22201
703 351-4504

Brian D. Oliver
President - Business Development

January 10, 1994

Dear: Chairman Hundt
Commissioner Quello
Commissioner Barrett
Commissioner Duggan

Enclosed for your consideration is an important independent study prepared by Comsat laboratories for Bell Atlantic Enterprises which confirms that LMDS in the 28 GHz band will not interfere with current and proposed Ka-band satellite systems, including NASA's ACTS Program, the proposed IRIDIUM program, and future Project 21 geostationary and intermediate circular orbit (ICO) satellite configurations. Comsat's analysis further concludes that potential interference from LMDS video distribution with proposed 28 GHz based satellite systems in the Ka-band would be so insignificant that it would meet the CCIR criteria by being at least 10dB below ambient thermal noise levels.

Comsat's unequivocal rebuttal of the NASA interference issue establishes beyond any doubt the fact that the pro-consumer LMDS service that Suite 12 is currently offering as a competitive alternative to cable in New York, can coexist in a spectrum efficient fashion with current and possible future FSS usage of the 28 GHz band.

Now that the NASA interference issue has been formally rebutted in the LMDS Rulemaking by Comsat, a primary architect of NASA's ACTS program, the Commission should move forward promptly to adopt its thoughtfully reasoned NPRM as this action will insure the immediate deployment of the exciting and highly competitive LMDS technology. Prompt licensing of LMDS as proposed in the FCC NPRM -- with two 1000 MHz licenses in the 28 GHz band -- will be consistent with explicit Congressional intent that the valuable spectrum, which is largely fallow in the 28GHz band, be robustly used in a manner that will promote competition while simultaneously generating substantial revenues from federal auctioning of this valuable public resource.

Allowing the 28 GHz spectrum to be hoarded now for proposed possible use five or ten years into the future is simply not in the public's interest, especially when the Comsat study in the LMDS Rulemaking Record definitely confirms that co-existence is feasible between LMDS and FSS service in the 28GHz.

Brian D. Oliver

COMSAT CORPORATION

C. Thomas Faulders, III
Vice President and
Chief Financial Officer

6560 Rock Spring Drive
Bethesda, MD 20817
Telephone 301 214 3333
Fax 301 214 7131

January 5, 1994

Mr. Brian D. Oliver
President, Business Development
Bell Atlantic Enterprises
1310 N. Courthouse Road
Arlington, Virginia 22201

Dear Brian:

As you know, COMSAT is a strong supporter of NASA's ACTS Experimental Satellite System and is presently participating in a number of program experiments to explore the characteristics of Ka-band frequencies for satellite communications of all kinds. Our hope is that by this participation, the usefulness of the Ka frequency band can be quantified for commercial satellite communications in the future. Given the interest in the future use of the Ka-band by satellite systems, it is particularly important that the ACTS program be in a position to complete its studies without undue interference or undue restriction in its operation.

Per your request, COMSAT Laboratories have carefully studied the issue of potential interference from LMDS into proposed Ka-band satellite systems. The attached report clearly demonstrates that the interference from LMDS into proposed Ka-band satellite systems meets the CCIR criteria for interference to be at least 10 dB below ambient thermal noise.

COMSAT Laboratories is available to further assist you on this matter.

Sincerely,

CFaulders

Interference From Ka-Band LMDS Video Signals To Ka-Band Satellites

January 4, 1994

COMSAT Laboratories
22300 COMSAT Drive
Clarksburg, Maryland 20871

EXECUTIVE SUMMARY

This report summarizes COMSAT Laboratories' assessment of the interference from Ka-band (27.5- to 29.5-GHz) Local Multipoint Distribution Services (LMDS) video signal transmitters into current and proposed Ka-band satellites. These satellite systems include ACTS type geostationary (GEO) satellites, IRIDIUM type low-earth orbit (LEO) satellites and proposed Project 21 geostationary (GEO) and intermediate circular orbit (ICO) type satellite configurations. For interference computations, the analysis included the combined effects of interference coming from LMDS antenna direct radiation, backlobes or sidelobes, and from diffused signal scatter off the ground into Ka-band satellites. In these cases, analysis showed that the interference from LMDS video distribution into proposed satellite systems in the Ka-band meets the CCIR criteria for interference to be at least 10 dB below ambient thermal noise. Since the LMDS antenna performance was considered critical in assessing the LMDS signal interference into satellite systems, COMSAT Laboratories made an independent validation of the antenna patterns by participating in measurements on a representative scale model of the antenna.

COMSAT Laboratories also reviewed the potential for interference from a LMDS hub transmitter into a 27.5-GHz earth station beacon receiver for ACTS-type satellites. This satellite to ground beacon is used for uplink power control. It was concluded that potential interference from LMDS with beacon reception can be adequately handled through a combination of frequency separation of the LMDS band-edge away from 27.5-GHz and normal filtering.

INTRODUCTION

COMSAT Laboratories performed a study of interference from Ka-band (27.5- to 29.5-GHz) Local Multipoint Distribution Service (LMDS) transmitters into Ka-band satellites. The scope of the study has been limited to interference from video distribution signals into current and proposed Ka-band satellites. The video distribution services are of the type being offered in the New York market under a waiver license by the FCC. Specifically, the following four separate cases were examined:

- NASA ACTS type satellites with spot or CONUS beams.
- IRIDIUM type LEO satellites with a 5° beam.
- Project-21 type ICO spot or global beam.
- Project-21 type GEO spot or global beam.

In addition, the potential interference from a LMDS hub transmitter with a 27.5-GHz beacon receiver signal (for uplink power control) into a satellite ground station was examined. The results of the study and related key conclusions are summarized in this report. A number of interference modes including contributions of LMDS antenna direct radiation, backlobes or sidelobes, and diffused signal scatter off the ground into Ka-band satellites were included in the interference analysis. The performance of the LMDS transmitter antenna was considered critical in providing interference protection to the satellite systems. Therefore, the LMDS antenna patterns were verified during the course of this study.

LMDS CELL TRANSMIT ANTENNA

A transmit antenna located at the center of each cell in the LMDS system broadcasts video signals to all subscribers. This antenna is designed to radiate energy towards the horizon, with a slight downward tilt, thus providing a pancake shaped radiated beam in all directions. The pattern should be very directive in elevation with a 4° to 8° 3-dB beamwidth and a radiation peak between 0° and -5° elevation. It should be isotropic in the azimuth plane at the elevation beam peak angle. The pattern sidelobes should fall off rapidly in both directions away from the elevation main beam. An antenna with these ideal characteristics will have a gain between 10 and 14 dBi. Figure 1 shows the mask associated with the radiation pattern for such an antenna.

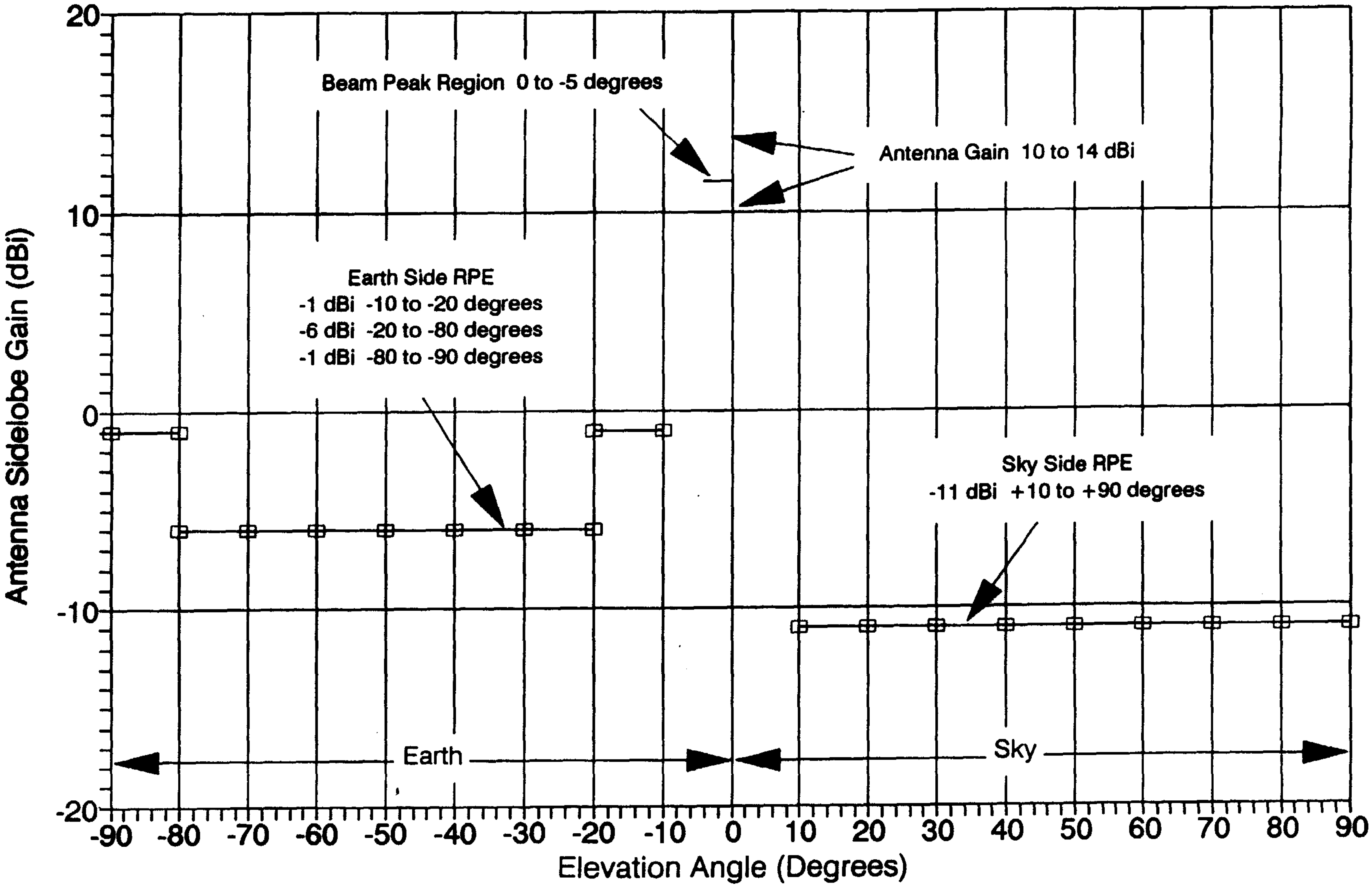
LMDS TRANSMIT ANTENNA PATTERN VERIFICATION

Andrew Corporation was identified as a potential supplier of LMDS antennas. Andrew Corporation has performed measurements on a prototype scale model antenna with an antenna gain of 12.1 dBi (Figure 2). This scale model operates over a 10- to 15-GHz frequency range. Scaling the performance of this representative antenna to 27.5- to 29.5-GHz should provide similar results for this antenna geometry. The measured performance of this antenna shows that it is reasonable to expect -13 dBi gain from the transmit antenna for elevation angles greater than 10°. The pattern also demonstrates the recommended discrimination below the horizon. This measured antenna pattern is for a linear vertical polarization. Similar performance is expected for a linear horizontal polarization. To gain confidence and validate the antenna design, a COMSAT Laboratories' antenna engineer witnessed measurements on the scale model prototype antenna and verified performance. Based on these tests, COMSAT believes that acceptable LMDS antenna performance is technically feasible and reasonably achievable. For the interference computations discussed in this report, the sidelobe discrimination given by the radiation pattern (Figure 2) was assumed.

INTERFERENCE AT THE SATELLITE CAUSED BY GROUND SCATTERING

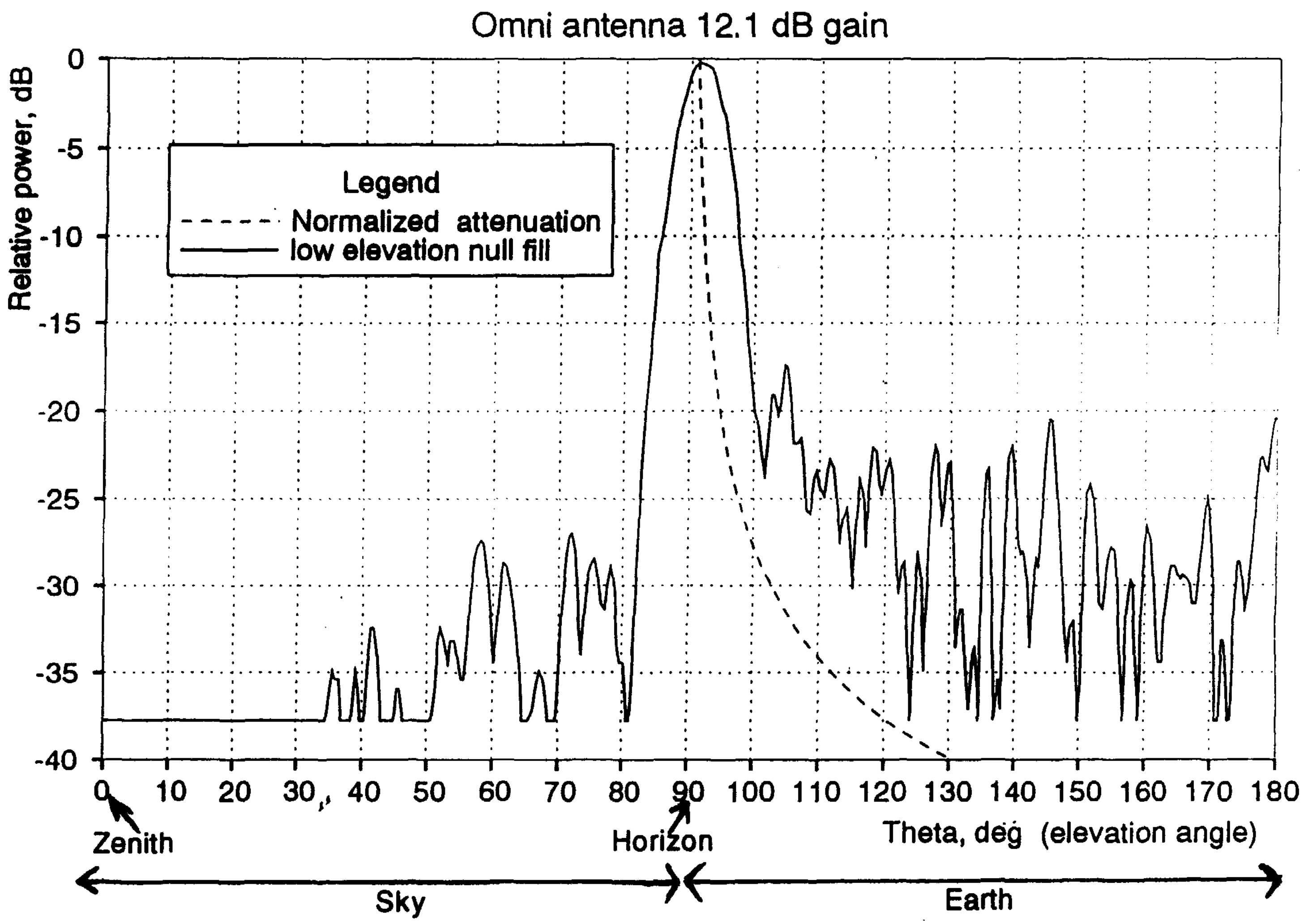
The main-lobe of LMDS transmitting antenna is either directed towards the horizon or at angles down to -5°. The signals reaching the ground from the main-lobe and the side-lobes will be reflected and scattered in different directions and have the potential to cause satellite interference. The interference level will largely depend on the type of ground, man-made structures near the LMDS hub station, and the elevation angle to the satellite. For calculation of interference levels a simple technique involving diffuse scattering from rough surfaces was used to obtain approximate levels of interference at satellites. The diffuse scattering coefficient can be used to estimate the

Figure 1. Recomended LMDS Cell Transmit Antenna Radiation Pattern Sidelobe Envelope Specification



Transmit sidelobes must fall below the radaiation pattern envelope (RPE) shown for the elevation plane

Figure 2 Andrew Corporation Measured LMDS Transmit Antenna Pattern



incoherent power received at the satellite which originates in an area close to the LMDS hub station. In the following analysis related to ACTS type satellites, a worst case diffuse scattering coefficient of -14 dB was assumed (CCIR Rep 1008-1). This diffuse scattering coefficient is appropriate for a highly rough surface. The effective antenna gain of reflecting surfaces scattering energy in all directions is assumed to be 3 dBi (hemispherical pattern). Signals from the LMDS antenna radiating towards objects in the cell which may specularly reflect energy towards the satellite were also considered. The probability of perfect multiple reflecting surfaces oriented at exactly the correct angle to reflect energy towards a particular satellite direction is small and interference from specular reflections appears improbable. With these assumptions, the contributions of interference power at the satellite due to diffuse scatter are summarized in Table 1. These computed interference power values have been included in the interference analysis discussed in the next section.

Table 1 Geostationary Satellite (ACTS) Example:

	ACTS CONUS	ACTS Spot
LMDS Transmit Power	10 dBW	10 dBW
Equivalent Antenna Gain	3 dBi	3 dBi
LMDS EIRP	-77 dBW/Hz	-77 dBW/Hz
Spectrum Peaking	3 dB	3 dB
Polarization Reuse	3 dB	3 dB
Frequency Interleaving	3dB	3dB
Average Path loss	214 dB	214 dB
Atmospheric Loss	1 dB	1 dB
Satellite antenna gain	32 dB	53 dB
Diffuse reflection coefficient	-14 dB	-14 dB
Number of LMDS hub stations (100% pop.)	57471	813
No. of LMDS hub stations (w/pop. Factor) * Population factor: * 10% (CONUS) 26% (Spot)	5747*	211*
Interference power at the satellite (100% pop.)	-229 dBW/Hz	-227 dBW/Hz
Interf. power at the satellite (w/pop. factor)	-239 dBW/Hz	-233 dBW/Hz
Satellite system noise temperature	900 K	900 K
Noise power at the satellite	-199 dBW/Hz	-199 dBW/Hz
CCIR Maximum allowable interference level	-209 dBW/Hz	-209 dBW/Hz

INTERFERENCE ANALYSIS

For the interference analysis, four satellite configurations were considered. The LMDS hub antenna side-lobe gain, path loss to the satellite, atmospheric loss and satellite antenna gain were included in this interference analysis. Factors such as spectrum peaking (3 dB) of FM signals, use of horizontal and vertical polarization in adjacent cells (-3 dB), and the effect of frequency interleaving between nearest cells of identical polarization (-3 dB) were also included.

The effect of population density on the potential number of LMDS transmitters was also considered. Based on studies done by Rand McNally and the US Department of Commerce more than 75% of the US population lives in an urban area [1], [2], and 90% of the US population lives on less than 10% land area for the conus coverages, therefore, the number of LMDS transmitters is taken to be 10% of the number with a uniform distribution of LMDS transmitters. For the spot coverages, the most heavily populated Northeast corridor (Including NY, PA, DE, MD, DC and WV) [1], has 90% of the population living in 25.7% of the land area. Therefore, another computation was included with a 26% population concentration factor for spot beams.

The interference analysis and related assumptions are presented in the following subsections and in Tables 2 through 5.

NASA ACTS Type GEO Satellite with Spot or CONUS Beam (Table 2):

For this calculation the antenna gain parameters for spot and CONUS beams given by NASA for the ACTS satellite were used. For the spot beam the smallest (worst case) LMDS cell size of 3 miles radius (cell area of 28.3 square miles) was used whereas for CONUS coverage an average LMDS cell size of approximately 4 miles radius (cell area of 52.2 square miles) was used. Note that the EIRP per hub site was limited to 10dBW as required by the CCIR limit (Recommendation 406-6) instead of 13dBW. Noise temperature given by NASA [3] was used to compute the ambient noise level. In both the spot and CONUS beams, the total noise introduced by LMDS is less than the CCIR allowable level of 10dB below ambient.

Table 2 NASA ACTS Type GEO Satellite with Spot or CONUS Beam IRIDIUM

NASA ACTS

PARAMETER NAME	SPOT 26% pop conc	SPOT 100% pop conc	CONUS 10% pop conc	*UNITS*	*assumptions*
CELL VIDEO TX HPA SIZE	100	100	100	WATTS	Suite-12
TX HPA SIZE (dB)	20	20	20	dBW	
RADIATED VIDEO POWER	13	13	13	dBW	7 dB output backoff
CCIR LIMIT	10	10	10	dBW	sets limit, used below
TOTAL VIDEO BANDWIDTH	1000	1000	1000	MHz	Suite-12
BANDWIDTH (dB)	90	90	90	dB-Hz	
SPECTRUM PEAKING	3	3	3	dB	Gaussian shape, FM
POLARIZATION REUSE	3	3	3	dB	1/2 vertical, 1/2 horizontal
FREQUENCY INTERLEAVING	3	3	3	dB	staggered frequency plan
HUB ANTENNA SIDELOBE GAIN	-13	-13	-13	dBi	≥10 deg elevation
PATH LOSS TO SATELLITE	214	214	214	dB	
ATMOSPHERIC LOSS	1	1	1	dB	
SATELLITE ANTENNA GAIN	53	53	32	dBi	NASA
Rx WATTS/Hz per VIDEO HUB	-258	-258	-279	dBW/Hz	
AVERAGE CELL SIZE	28.3	28.3	52.2	sq miles	rain zone dependent
COVERAGE AREA sat beam	23000	23000	3000000 (conus coverage)	sq miles	NASA
POP. CONCENTRATION FACTOR	26	100	10	percent	1994 Rand McNally Guide
# OF HUBS per BEAM	211	813	5747	hubs per beam	
Rx WATTS/Hz backlobe	-234.8	-228.9	-241.4	dBW/Hz	
Rx W/Hz diffuse scatter	-232.8	-226.9	-239.4	dBW/Hz	
Rx TOTAL	-230.6	-224.8	-237.3	dBW/Hz	
SATELLITE NOISE TEMP eq.	900	900	900	Kelvin	NASA
THERMAL DENSITY AT SAT	-199.1	-199.1	-199.1	dBW/Hz	
MARGIN TO CCIR LEVEL	21.6	15.7	28.2	dB	
MARGIN wrt AMBIENT	31.6	25.7	38.2	dB	

Type LEO Constellation 5° Beam (Table 3):

In this calculation, parameter values were taken from IRIDIUM documents [4], including the number of hubs per beam. The computed interference level from LMDS was calculated to be about -20dB from ambient noise, which is about 10dB lower than the CCIR guideline of -10dB from the ambient. Because of the lower path loss to the satellite, this example has the least amount of interference margin of the four cases studied.

Project-21 ICO Spot or Global Beam (Table 4):

Project-21 designs have not yet been finalized. However, an Inmarsat sponsored Ka-band feeder link preliminary space segment design for ICO has been completed. The concept involves the use of both global beams and spot beams. The projected antenna gain and noise temperature from the preliminary design have been used in these calculations. Analysis shows at least 17dB margin as compared to the CCIR guideline of -10dB interference levels from the ambient noise.

Project-21 GEO Spot or Global Beam (Table 5):

In this calculation, the same antenna gains and noise temperatures from the ICO preliminary design were used to compute interference. This particular combination of Ka-Band with GEO is highly conjectural, but it represents one possible way a Project-21 system could be realized. For both spot and global beams in a GEO satellite analysis shows at least 20dB margin as compared to CCIR guideline of interference levels of -10dB from the ambient noise.

Summary

The interference power from backlobes and diffuse scatter of LMDS into representative satellites at Ka-Band with representative parameters, has been shown to yield noise levels that are below the CCIR recommended levels of 10dB below the ambient noise of the satellites.

Table 3 IRIDIUM Type LEO Constellation 5° Beam

IRIDIUM

PARAMETER NAME	5 degree beam 100% pop conc	5 degree beam 26% pop conc	*UNITS*	assumptions
TX HPA SIZE	100	100	WATTS	Suite-12
TX HPA SIZE (dB)	20	20	dBW	
RADIATED VIDEO POWER	13	13	dBW	7 dB output backoff
CCIR LIMIT	10	10	dBW	sets limit on power
TOTAL VIDEO BANDWIDTH	1000	1000	MHz	Suite-12
BANDWIDTH (dB)	90	90	dB-Hz	
SPECTRUM PEAKING	3	3	dB	Gaussian shape, FM
POLARIZATION REUSE	3	3	dB	1/2 horiz, 1/2 vert
FREQUENCY INTERLEAVING	3	3	dB	staggered frequency plan
HUB ANTENNA SIDELOBE GAIN	-13	-13	dBi	≥10 deg elevation
PATH LOSS TO SATELLITE	190	190	dB	average
ATMOSPHERIC LOSS	1	1	dB	
SATELLITE ANTENNA GAIN	30.1	30.1	dBi	IRIDIUM
Rx WATTS/Hz per VIDEO HUB	-256.9	-256.9	dBW/Hz	
AVERAGE CELL SIZE	52.2	52.2	sq miles	Suite-12
COVERAGE AREA (approx)	84900	84900	sq miles	
# of HUBS per BEAM (MOTOROLA)	3000	780	hubs per beam	MOTOROLA ASSUMPTION
Rx WATTS/Hz backlobe	-222.1	-228.0	dBW/Hz	
Rx W/Hz diffuse scatter	-220.1	-226.0	dBW/Hz	
Rx W/Hz total	-218.0	-223.9	dBW/Hz	
SATELLITE NOISE TEMP eq.	1288	1288	Kelvin	IRIDIUM
THERMAL DENSITY AT SAT	-197.5	-197.5	dBW/Hz	
MARGIN TO CCIR REQ.	10.5	16.4	dB	
MARGIN wrt TO AMBIENT	20.5	26.4	dB	

Table 4 Project-21 ICO Spot or Global Beam

ICO PROJECT-21	SPOT	SPOT	GLOBAL	*UNITS*	*assumptions*
	26% pop conc factor	100% pop conc factor	10% pop conc factor		
PARAMETER NAME					
CELL VIDEO TX HPA SIZE	100	100	100	WATTS	Suite-12
TX HPA SIZE (dB)	20	20	20	dBW	
RADIATED VIDEO POWER	13	13	13	dBW	
CCIR LIMIT	10	10	10	dBW	sets limit on power
TOTAL VIDEO BANDWIDTH	1000	1000	1000	MHz	Suite-12
BANDWIDTH (dB)	90	90	90	dB-Hz	
SPECTRUM PEAKING	3	3	3	dB	Gaussian shape, FM
POLARIZATION REUSE	3	3	3	dB	
FREQUENCY INTERLEAVING	3	3	3	dB	
HUB ANTENNA SIDELOBE GAII	-13	-13	-13	dBi	
PATH LOSS TO SATELLITE	206	206	206	dB	
ATMOSPHERIC LOSS	1	1	1	dB	
SATELLITE ANTENNA GAIN	39.5	39.5	19.5	dBi	preliminary Project-21
Rx WATTS/Hz per VIDEO HUB	-263.5	-263.5	-277.5	dBW/Hz	
AVERAGE CELL SIZE	28.3	28.3	52.2	sq miles	Suite-21
COVERAGE AREA sat beam	147642	147642	3089000	sq miles	computed
	elongated ellipse	**elongated ellipse**	**[spherical area visible]**		
POP CONC FACTOR	26	100	10	%	
# OF HUBS per BEAM	1356	5217	5918	hubs per beam	
Rx WATTS/Hz backlobe	-232.2	-226.3	-239.8	dBW/Hz	
Rx W/Hz diffuse scatter	-230.2	-224.3	-237.8	dBW/Hz	
Rx W/Hz total	-228.1	-222.2	-235.7	dBW/Hz	
SATELLITE NOISE TEMP eq.	2500	2500	2500	Kelvin	preliminary Project-21
THERMAL DENSITY AT SAT	-194.6	-194.6	-194.6	dBW/Hz	
MARGIN TO CCIR LEVEL	23.4	17.6	31.0	dB	
MARGIN wrt AMBIENT	33.4	27.6	41.0	dB	

Table 5 Project-21 GEO Spot or Global Beam

GEO PROJECT-21	SPOT	GLOBAL		
PARAMETER NAME			*UNITS*	*assumptions*
CELL VIDEO TX HPA SIZE	100	100	WATTS	Suite-12
TX HPA SIZE (dB)	20	20	dBW	
RADIATED VIDEO POWER	13	13	dBW	
CCIR LIMIT	10	10	dBW	sets limit on power
TOTAL VIDEO BANDWIDTH	1000	1000	MHz	
BANDWIDTH (dB)	90	90	dB-Hz	Suite-12
SPECTRUM PEAKING	3	3	dB	Gaussian spectra, FM
POLARIZATION REUSE	3	3	dB	
FREQUENCY INTERLEAVING	3	3	dB	
HUB ANTENNA SIDELOBE GAIN	-13	-13	dBi	≥10 deg elevation
PATH LOSS TO SATELLITE	214	214	dB	
ATMOSPHERIC LOSS	1	1	dB	
SATELLITE ANTENNA GAIN	39.5	19.5	dBi	Preliminary Project-21
Rx WATTS/Hz per VIDEO HUB	-271.5	-291.5	dBW/Hz	
AVERAGE CELL SIZE	52.2	52.2	sq miles	Suite-12
COVERAGE AREA sat beam	2000000	10000000	sq miles	
	elongated ellipse	**spherical area of 1/2 globe**		
POP CONC FACTOR	26	10	%	
# OF HUBS per BEAM	9962	19157	hubs per beam	
Rx WATTS/Hz backlobe	-231.5	-248.7	dBW/Hz	
Rx W/Hz diffuse scatter	-229.5	-246.7	dBW/Hz	
Rx total	-227.4	-244.6	dBW/Hz	
SATELLITE NOISE TEMP eq.	2500	2500	Kelvin	Preliminary Project-21
THERMAL DENSITY AT SAT	-194.6	-194.6	dBw per Hz	
MARGIN TO CCIR LEVEL	22.8	39.9	dB	
MARGIN wrt AMBIENT	32.8	49.9	dB	

DIRECT RADIATION FROM LMDS ANTENNA INTO SATELLITES

Direct radiation from the main beam of LMDS antennas into satellites were analyzed for LEO and ICO satellites when each satellite appears at the horizon. For this case, the satellite spot beam is assumed to be pointed such that the LMDS transmit antenna lies outside the satellite 5° spot beam.

For example, the interfering signal from the LMDS antenna into IRIDIUM-type LEO satellites increases by as much as 25dB because of direct radiation. However, this is compensated by an additional path loss of 5dB, additional atmospheric loss of 11dB, and a reduction in satellite antenna gain toward the interfering signal by more than 12dB. Therefore, the impact of direct radiation into satellites is considered minimal assuming the same number of LMDS hub stations as shown in Table 3.

INTERFERENCE TO 27.5 GHz BEACON RECEPTION

Ka-band satellite systems can take advantage of down-link beacon allocations at 27.5- and 30.0-GHz to implement rain fade mitigation techniques. The proposed LMDS frequency band overlaps with the 27.5-GHz allocation and thus the reception of the beacon signal may be interfered with by the LMDS signals if the earth station receiving the beacon is situated close to an LMDS hub station. The following example shows the interference level at an earth station located 10 km away from an LMDS hub station. The following assumptions were used in the analysis of co-frequency operation:

i. Beacon EIRP is 10 dBW
ii. Earth station receiving the beacon has an antenna gain of 50 dBi; the side-lobe in the direction of the interfering LMDS hub has a gain of 7dBi assuming a satellite elevation angle of 10° [32 - 25log(10°)dBi]
iii. LMDS EIRP towards earth station is 24 dBW (Tx. power: 13 dB, Feed loss: 1 dB, Antenna gain: 12 dBi, and is assumed to be uniform in distribution throughout the band.

Beacon EIRP at satellite	10 dBW
Effective beacon signal bandwidth	100 Hz
Path loss	215 dB
Receive antenna gain	50 dBi

Received carrier power level	-175 dBW/Hz
LMDS transmit power	13 dBW
Feed loss	1 dB
Bandwidth	1 GHz
Transmit antenna gain	12 dBi
Transmit EIRP/Hz	-66 dBW/Hz
Path loss at 10 Km	142 dB
Receive antenna gain in the horizon	7 dBi
Received interference power level	-201 dBW/Hz
C/I at the receiver	26 dB
Typical carrier to noise (C/N) for beacon reception	30 dB

C/I must be greater than 35 dB for adequate use of the beacon for up-link power control or any other fade mitigation purpose.

Interference from LMDS with beacon reception can be reduced simply by the exclusion of frequencies close to 27.5-GHz from LMDS transmissions. For the example interference scenario shown above, a reduction in interference level of 9 dB is required. This may be easily achieved by placing the LMDS band-edge 10-MHz away from the beacon frequency (approximately 30 dB isolation through filtering), understood to be part of the present LMDS frequency plan.

SUMMARY AND CONCLUSIONS

The interference analysis has shown that the interference from LMDS video distribution into proposed Ka-band satellite systems meets the CCIR criteria for interference to be at least 10 dB below ambient thermal noise with some margin. Investigation of the potential interference of LMDS signals into 27.5-GHz beacon reception shows that with a combination of frequency separation of the LMDS signal (from 27.5-GHz) and normal filtering, beacon receiver interference can be avoided.

REFERENCES

1. "Rand McNally 1994 Commercial Atlas and Marketing Guide" 125th Edition

2. "Urban Population Tops 75% Mark for First Time," US Department of Commerce News, Dec. 18, 1991.

3. "Comments of the National Aeronautics and Space Administration" on LMDS to the Federal Communications Commission dated March 16, 1993.

4. "Motion of Motorola Satellite Communications, Inc. for Leave to File Supplemental Comments" on LMDS to the Federal Communications Commission dated November 22, 1993.